Implementing Best Practices in the Joint Battlespace Infosphere (JBI) Program at AFRL

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Data and Analysis Center for Software (DACS)

OSD/SEI (sponsored)

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Presentation Outline

Section I ……DACS “Best Practice” Initiative

Section II ……The JBI Program at AFRL

Section III ……”Best Practices” on JBI

Section IV ……Ending Remarks

Section I

DACS "Best" Practice Initiative

Goals:

- To provide the DoD acquisition community with **"value added"** information about "Best" practices
  - "One-stop shopping"
  - Information tailored to the needs of individuals
- To monitor "best" practice implementation within the DoD community
  - extend and expand upon the research of Dr. Richard Turner, OSD, relating to implementation of "best" practices within the DoD
  - Find ways to measure/assess the "value added" by best practice implementation
- To identify and report on new or emerging "best" practices

Synopsis of Turner's Research

To what degree have existing SIS projects within DoD adopted best practices?

Activities:

- Developed and conducted a survey to establish **awareness of**, **implementation, and perceived effectiveness** of a set of 32 best practices
  - Participants were military software centers of excellence –covering 90% of acq. programs
  - Practice effectiveness evaluated by a panel of experts

Some Findings & Observations:

- Despite widespread awareness, there is very little actual implementation – therefore little value is being realized.
- Managers are aware of – but choose not to implement - BPs. (Note several barriers)
  - Some practices are considered effective but do not directly impact on high risk areas
- Practices are constantly evolving; current BP may not reflect future BP
- Practices may interact significantly with each other – crucial to selecting.

Turner, R.G., "Implementation of Best Practices in U.S. Department of Defense Software-Intensive System Acquisitions", Ph.D. Dissertation, George Washington University, 31 January 2002

DACS Best Practice (BP) Activities

- **Continued Research** on "best" practice
- **BP Profiles**
  - **Individual Documents** (for each practice)
- **BP "Architecture"**
  - Describes the influences and relationships among the practices
- **ON-GOING Survey**
  - Extends Dr. Turner's survey
  - Addresses awareness and implementation of BPs
  - Collects information on practice interrelationships and influences
- **DACS BP Web Site** (to be developed)
  - Disseminate/Broker BP information and resources
  - Collect, analyze, and disseminate survey results
  - Review or participate in discussion forum
  - Review or submit case studies

"Best" vs. "Gold" Practices

A "Best" Practice (BP) is …

- A documented practice aimed at lowering an identified risk in a system acquisition and is required or recommended by a bona fide DoD, industry, or academic source. [Turner, 2002]

- Methodologies and tools that consistently yield productivity and quality results when implemented in a minimum of 10 organizations and 50 software projects, and is asserted by those who use it to have been beneficial in all or most of the projects. [Jones, 2000]

A "Gold" Practice (GP) is …

- A practice that provides **intrinsic value** to an organization that develops software in terms of cost savings, product/process improvements, and/or lowering an identified risk **irrespective of whether or not it has been successfully implemented in other organizations**. [DACS, 2002]

DACS Gold Practices

Related to Quality
- Use Past Performance
- Statistical Process Control
- Compile and Smoke Test Frequently
- Binary Quality Gates at the Inch Pebble Level
- Model-Based Testing
- Formal Inspections
- Defect Tracking Against Quality Targets

Related to Risk
- Formal Risk Management
- Assess Reuse Risks and Costs

Related to Technical Performance
- Agreement on Interfaces
- Ensure Interoperability
- Leverage COTS/NDI
- Demonstration-Based Reviews
- Independent Expert Reviews

Related to Cost
- Track Earned Value
- Best Value Awards

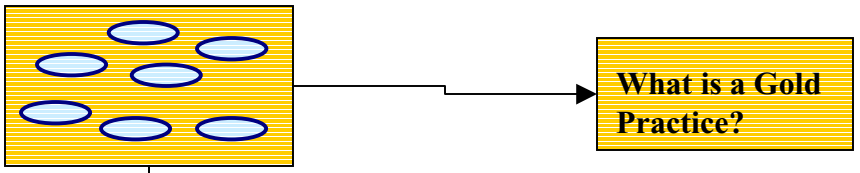
Related to Project Management
- Establish Clear Goals and Decision Points
- Common Management and Manufacturing Systems
- Metrics-Based Scheduling and Management
- Quantitative Progress Measurement
- Plan for Technology Insertion
- People-Aware Management Accountability
- Require Structured Development Methods (Iterative Processes)
- Configuration Management
- Program Wide Visibility of Progress vs.. Plan
- Develop and Maintain a Life-Cycle Business Case

Related to Requirements
- Performance Based Specifications
- Manage Requirements
- Commercial Specifications & Standards/ Open Systems
- Requirements Trade-Off/Negotiation

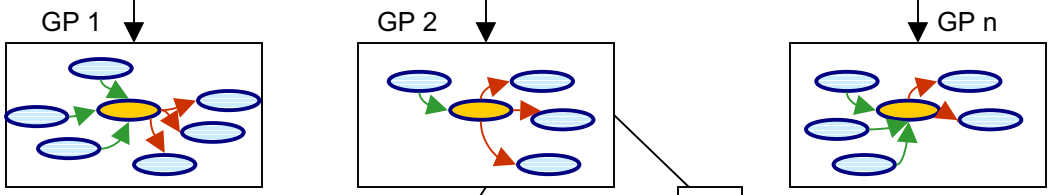
Related to Processes
- Architecture-First Approach
- Integrated Product and Process Development (IPPD)
- Acquisition Process Improvement
- Goal-Question-Metric Approach
- Capture Artifacts in Rigorous Model-Based Notation

4-Tier Approach to GP Info

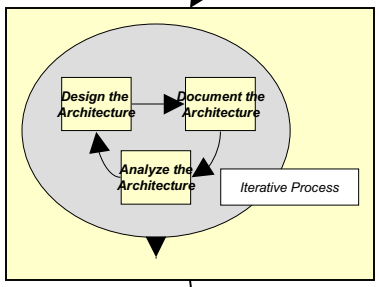
Level 1:
GP Selection List

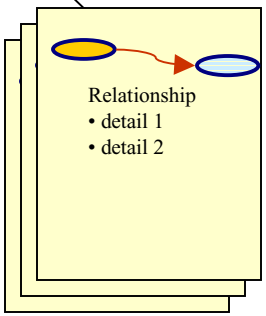


Level 2:
GP Architecture



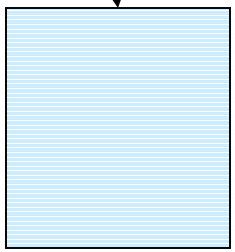
Level 3:
GP Practice Description



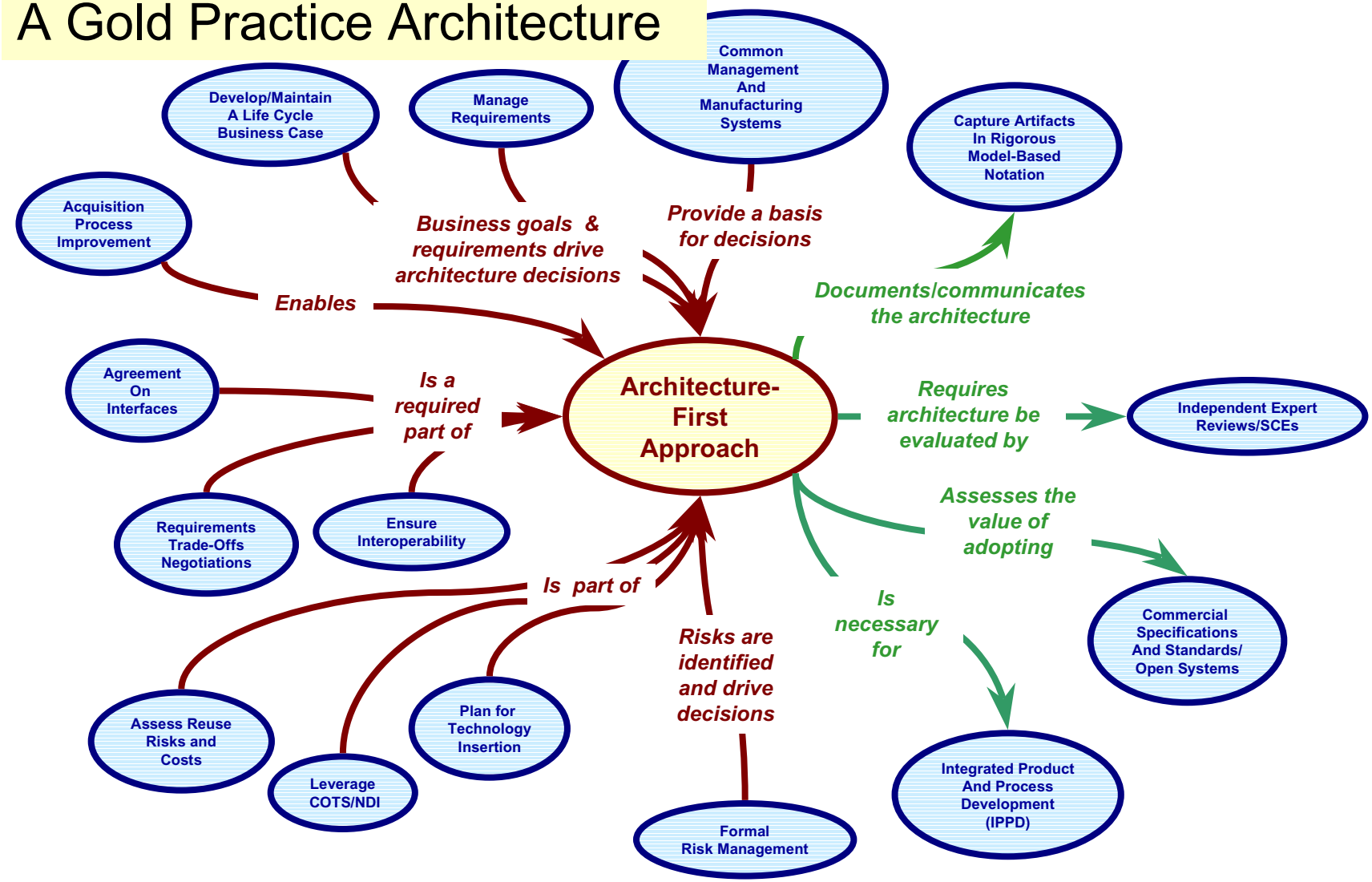


Level 3:
Relationship Details

Level 4:
Comprehensive GP Profile
(including environment)



A Gold Practice Architecture



"Architecture-First Approach" Profile Survey Form (Part 1 of 3-Part Survey)

Software Intensive System Acquisition Gold Practice Profile

Descriptive Characteristics														
1	**Name**	Architecture-First Approach												
2	**Description**	Achieving a demonstrable balance among driving requirements, architecturally significant design decisions, and the life-cycle plans before resources are committed for full-scale development.												
3	**Source**	Defense Science Board Task Force; Defense Software Collaborators; Interim Defense Acquisition Guidebook-30 Oct 2002; Royce, Software Engineering Institute												
4	**References**	Royce- Software Project Management; The Architecture Based Design Method (CMU/SEI-2000-TR-001); Architecture-Based Development (CMU/SEI-99-TR-007)												
5	**CMMI PA(S)**	Project Planning, Project Monitoring & Control, Measurement and Analysis											ID	
Qualitative Characteristics														
Select answers as described for each column and indicate your confidence in your answer. Confidence is expressed from 0 (none) to 10 (surely)														
Implementation Characteristics														
6	**Primary Benefit Area**	*Provide a quick indication of where practice has greatest impact (enter "X" into one box)*	Cost		Schedule		Quality		Risk		Technical Performance		Confidence	
7	**Secondary Benefit Area(s)**	*Show other areas where this practice has positive influence (Enter "X" into all appropriate boxes)*	Cost		Schedule		Quality		Risk		Technical Performance		Confidence	
8	**Specific Benefits**	*Describe specific benefits gained from the practice (e.g., What risks are reduced? How is technical performance improved? Why/how much is schedule/cost reduced?, etc.)*	<Text>											
9	**Life Cycle Phase(s) (as defined in DoD 5000)**	*Identify when in the acquisition life cycle this practice is* ***most*** *beneficial or effective (Enter "X" into one box)*	Concept and Technology Development		System Development and Demo		Production and Deployment		Maintenance				Confidence	
10	**Organizational Scope (Authority)**	*What is the lowest level of authority required to provide the necessary "strong support" to successfully implement this practice (Enter "X" into one box)*	Enterprise		Organization		Program		Project		Individual		Confidence	
11	**Primary Target**	*Which organization implements this practice (Enter "X" into one box)*	Acq. Org		Dev. Org.		Both						Confidence	
12	**Indications**	*Describe observable situations where this practice might be useful, i.e., what signs suggest this practice is appropriate*	<Text>											
13	**Contraindications**	*Describe situations or factors that indicate that this practice should not be used (e.g., high visibility, politically controversial, rigid requirements, etc.)*	<Text>											
14	**Appropriate Candidates**	*What types of acquisitions would this practice most likely benefit (e.g., software-only developments, legacy system upgrades)*	<Text>											
15	**Inappropriate Candidates**	*What types of projects would this practice not be appropriate for, or would receive less benefit*	<Text>											
16	**Unintended Consequences**	*What unintended negative consequences could result from implementation of this practice*	<Text>											
17	**Dependent Practices**	*Describe other specific practices that this practice may depend on in order for it to be effective (use supporting table)*	<Text>											
18	**Influenced Practices**	*Describe other specific practices that this practice may benefit in order for them to be effective (use supporting table)*	<Text>											
19	**Technology Adoption/Transfer**	*What new approaches or techniques are required to facilitate transfer/adoption of this practice*	<Text>											

"Architecture-First Approach" Profile Survey Form (Part 1 of 3-Part Survey) Continued

Benefits: Answer only if benefit area was selected in item 6. Measures are percentage of total life cycle costs.														
32	**Benefit to Cost**	*What is the average % total life cycle cost reduction due to this practice*	Very Low (<2%)		Low (2-5%)		Moderate (5-15%)		High (15-30%)		Very High (>30%)		Confidence	
33	**Benefit to Schedule**	*What is the average % of overall schedule reduction (time-to-market, time-to-fielding) due to this practice*	Very Low (<2%)		Low (2-5%)		Moderate (5-15%)		High (15-30%)		Very High (>30%)		Confidence	
34	**Benefit to Quality**	*What is the average % reduction of defects delivered to the user over the total life cycle of the product due to this practice*	Very Low (<2%)		Low (2-5%)		Moderate (5-15%)		High (15-30%)		Very High (>30%)		Confidence	
35	**Benefit to Technical Performance**	*What is the average % increase in technical performance and capability due to this practice*	Very Low (<2%)		Low (2-5%)		Moderate (5-15%)		High (15-30%)		Very High (>30%)		Confidence	
36	**Benefit to Risk**	*What is the average % decrease in overall program risk (comparison of composite cost, schedule, quality and technical performance risks) due to this practice*	Very Low (<2%)		Low (2-5%)		Moderate (5-15%)		High (15-30%)		Very High (>30%)		Confidence	
Thresholds: These are measures of program attributes which describe when the practice becomes beneficial.														
37	**Size Threshold for Value**	*How large must the program be (in number of software-related personnel) in order to gain sufficient value from the practice*	Any		Low (<10)		Nominal (10-50)		High (51-100)		Very High (>100)		Confidence	
38	**Duration Threshold for Value**	*How long must the acquisition program last (in years) before benefits from the practice are obtained*	Any		Short (<2)		Nominal (2-5)		Long (5-8)		Very Long (>8)		Confidence	
39	**Criticality Threshold for Value**	*How critical must the program be (relative to total life-cycle cost) before the benefits of this practice outweigh the implementation costs*	Any		Low (mission support)		Nominal (mission significant)		High (mission critical)		Very High (safety critical)		Confidence	

Comments: (Please provide reference to line item number)

<Text>

Case Study: If possible, describe one case study for this Best Practice for which you have personal knowledge. Include a general description of program background, then details of how this Best Practice impacted (positively or negatively) the program. Where possible, quantify cost, schedule, technical performance, quality and risk. Include as much detail as you feel appropriate (use extra sheets, if necessary).

descriptive Characteristics

"Architecture-First Approach" Profile Survey Form (Part 2 of 3-Part Survey)

Fill out these tables by entering a "P", "L" or Blank within each of the two tables, as described below

OTHER PRACTICES ON WHICH EFFECTIVENESS OF THIS PRACTICE DEPEN

P = OTHER PRACTICE ENHANCES EFFECTIVENESS OF THIS PRACTICE
L = OTHER PRACTICE LIMITS EFFECTIVENESS OF THIS PRACTICE
BLANK = NO APPARENT DEPENDENCY

Architecture-First Approach	
Acquisition Process Improvement	
Agreement on Interfaces	
Architecture-First Approach	
Assess Reuse Risks and Cost	
Best Value Awards	
Binary Quality Gates at the Inch-Pebble Level	
Capture Artifacts in Rigorous Model-Based Notation	
Commercial Specifications and Standards/Open Systems	
Common Management and Manufacturing Systems	
Compile and Smoke Test Frequently	
Configuration Management	
Defect Tracking Against Quality Gates	
Demonstration-Based Reviews (incl. Executable Architecture)	
Develop/Maintain a Life-Cycle Business Case	
Ensure Interoperability	
Establish Clear Goals and Decision Points	
Formal Inspections	
Formal Risk Management	
Goal-Question-Metric Approach	
Independent Expert Reviews/SCEs	
Integrated Product and Process Development	
Leverage COTS/NDI	
Manage Requirements	
Metrics Based Scheduling and Management	
Model-Based Testing	
People-Aware Management Accountability	
Performance-Based Specifications	
Plan for Technology Insertion	
Program-Wide Visibility of Progress vs. Plan	
Quantitative Progress Measurement	
Require Structured Development Methods	
Requirements Trade-Offs/Negotiations	
Statistical Process Control	
Track Earned Value	
Use Past Performance	

OTHER PRACTICES WHICH EFFECTIVENESS OF THIS PRACTICE INFLUENCE

P = THIS PRACTICE ENHANCES EFFECTIVENESS OF OTHER PRACTICES
L = THIS PRACTICE LIMITS EFFECTIVENESS OF OTHER PRACTICES
BLANK = NO APPARENT INFLUENCE

Architecture-First Approach	
Acquisition Process Improvement	
Agreement on Interfaces	
Architecture-First Approach	
Assess Reuse Risks and Cost	
Best Value Awards	
Binary Quality Gates at the Inch-Pebble Level	
Capture Artifacts in Rigorous Model-Based Notation	
Commercial Specifications and Standards/Open Systems	
Common Management and Manufacturing Systems	
Compile and Smoke Test Frequently	
Configuration Management	
Defect Tracking Against Quality Gates	
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Performance-Based Specifications	
Plan for Technology Insertion	
Program-Wide Visibility of Progress vs. Plan	
Quantitative Progress Measurement	
Require Structured Development Methods	
Requirements Trade-Offs/Negotiations	
Statistical Process Control	
Track Earned Value	
Use Past Performance	

"Architecture-First Approach" Profile Survey Form (Part 3 of 3-Part Survey)

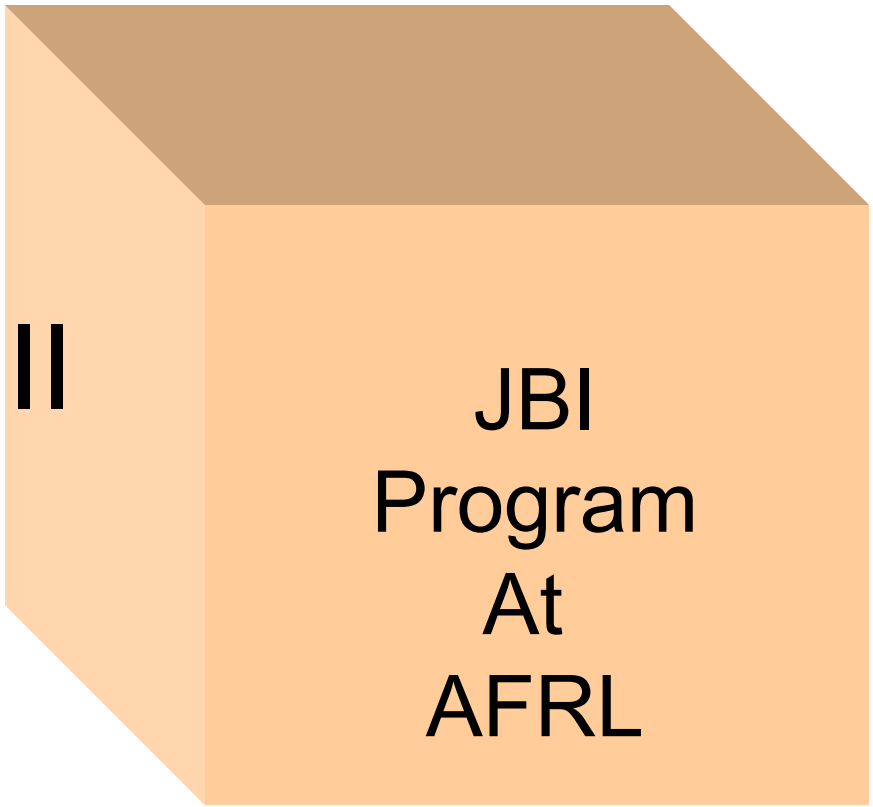
PRACTICE	RISK CATEGORIES									
	High			Medium					Low	
	SE	PR	RQ	ES	PE	ST	WE	MN	QA	CN
Architecture-First Approach										

Enter "D" if Practice has direct impact on risk category
Enter "I" if Practice has indirect impact on risk category
Leave blank if Practice has no/negligible impact on risk category

The Risk Categories considered in this part of the survey are:

- SE: System Engineering
- PR: Process
- RQ: Requirements Quality/Stability
- ES: Estimation
- PE: Policy/External
- ST: Staffing
- WE: Working Environment
- MN: Monitoring
- QA: Product Quality
- CN: Contracting

Section II



What is the problem?

- **Too much information** - from multiple sources/sensors and residing across a multitude of systems
- Current C2ISR tools only get us partway there
  - **Large monolithic**, rigid enterprises
  - Unique information infrastructures
  - Information interoperability issues
  - System admin & configuration overhead
- Decision-maker must **filter & aggregate**
- Interfaces between systems and & brand new enterprise systems **cost-prohibitive (time & $$)**
- Results from the Kosovo experience:
  - "Info fatigue"
  - "Cyber- rubbernecking"

Opportunity!

Leverage on commercial IT investment

- Commercial IT advancing at a staggering pace
- Commercial IT Enterprises face the same dilemma

Is there a solution?

JBI Goals & Challenges

- Increase **affordability and flexibility** of future information systems supporting the war fighter
- Provide an **open**(standards-based) and **extensible infrastructure** upon which **legacy, evolving, and future** information systems will operate

- Achieve universality
- Become technology agnostic
- Achieve legacy client integration
- Embrace and manage many domains
- Achieve scalability
- Create a technical architecture that does not constrain the solution space

What is JBI?

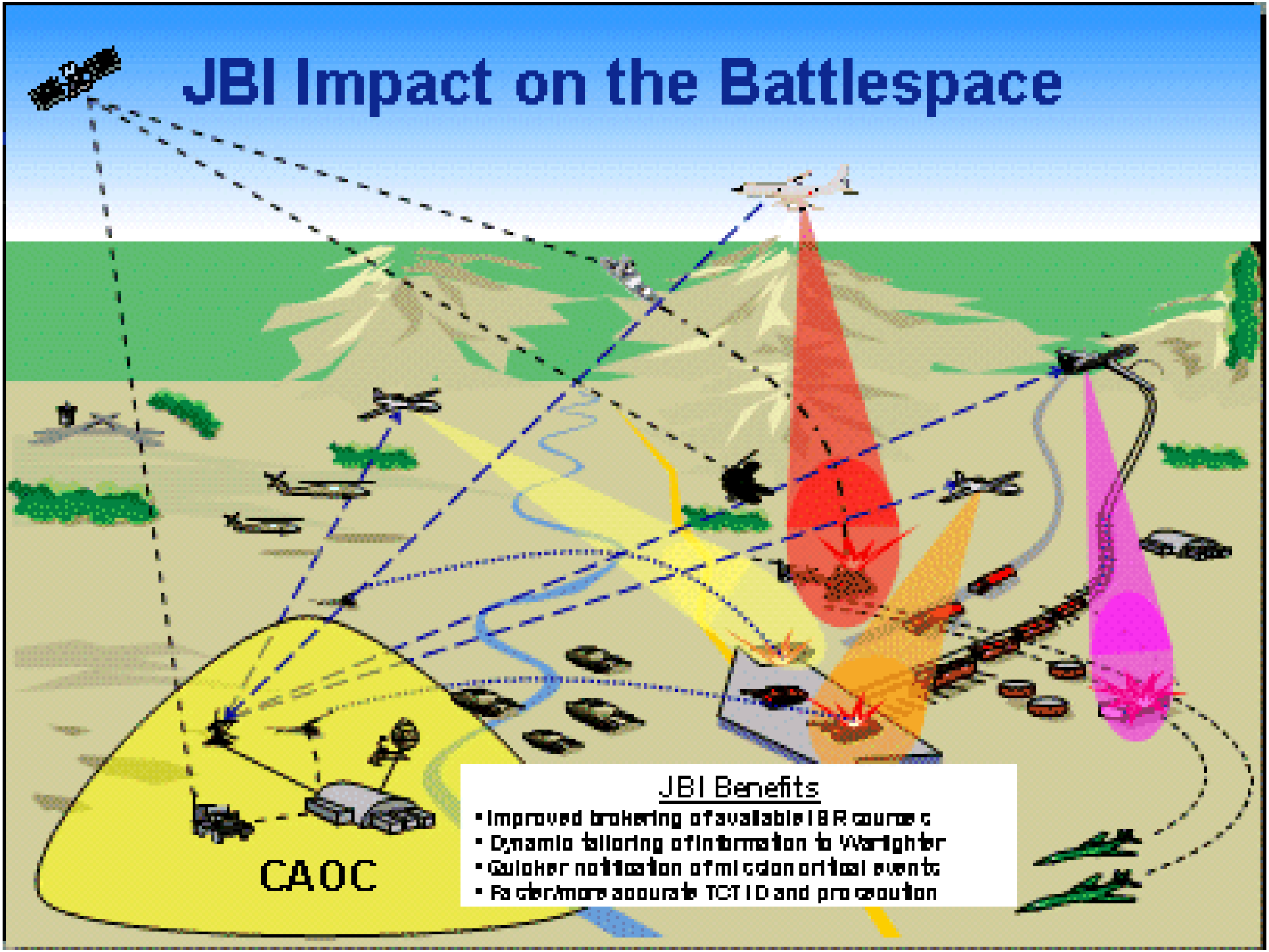
a concept of a capability …

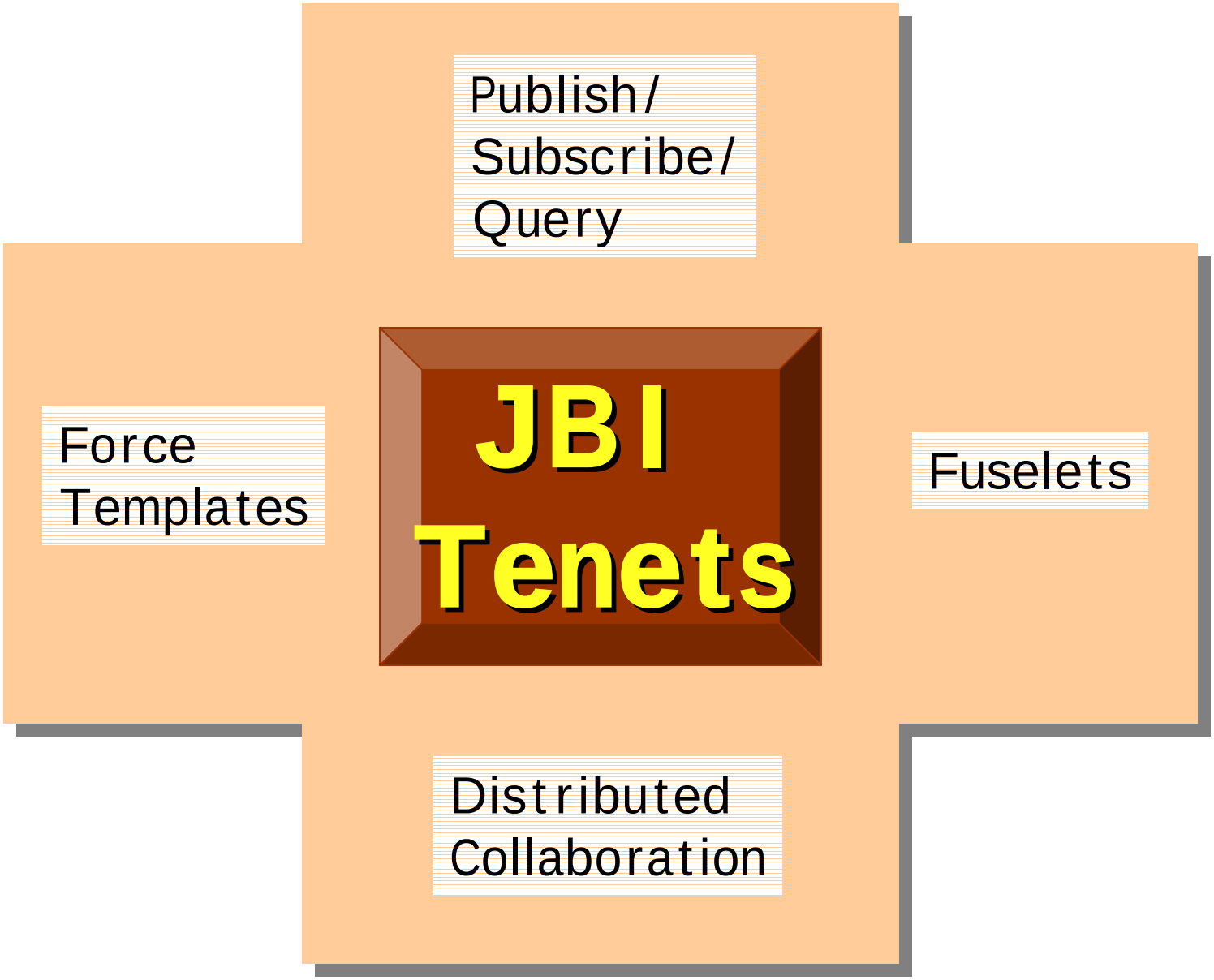
- A combat information management system which provides users with specific information required to perform their functional responsibilities during crisis or conflict. [SAB report 1999]

- A system of systems that
  - Integrates, aggregates, and distributes information
  - To users at all echelons – from the command center to the battlefield

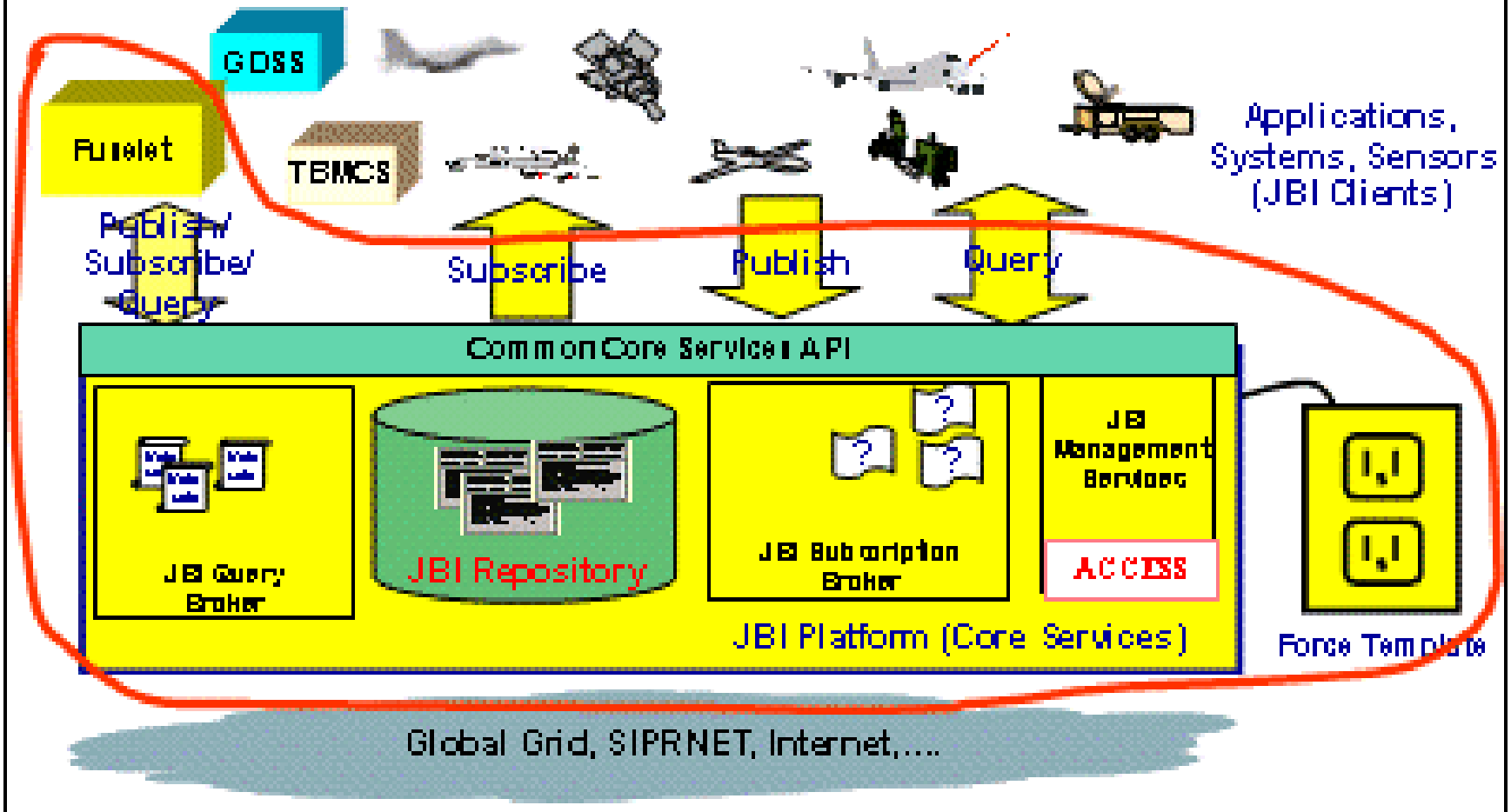
•Reference "Information Management to Support the Warrior" (1998), and "Building the Joint Battlespace Infosphere" (1999) published by the Air Force Scientific Advisory Board

JBI Impact on the Battlespace




Publish/
Subscribe/
Query
Force
Templates
JBI
Tenets
Fuselets
Distributed
Collaboration

What does a JBI look like?



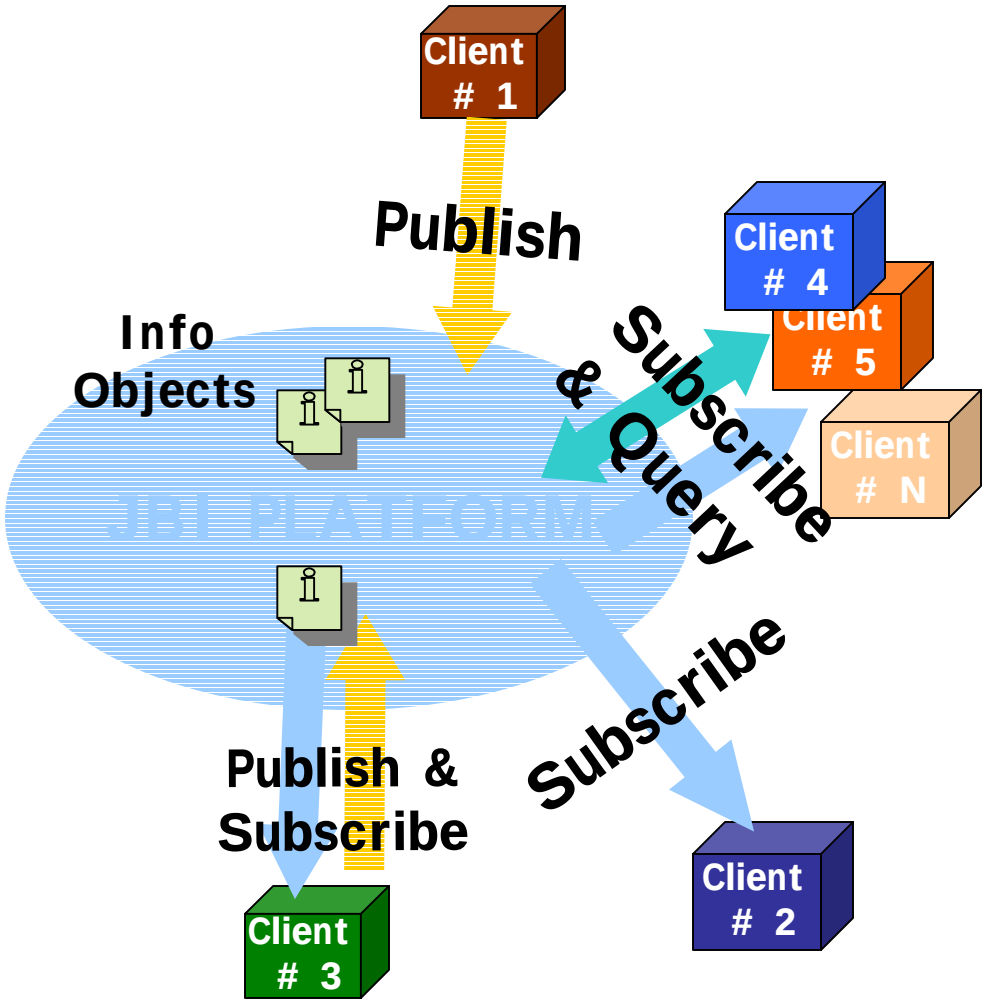
Publish, Subscribe & Query

"Foundation of the JBI"

Clients **publish** information objects: object type, metadata & and data(payload)

Clients **subscribe** to information - look forward in time for objects (Give me all objects of type "A" from source K with attributes "m","n" & "s" – as they are published)

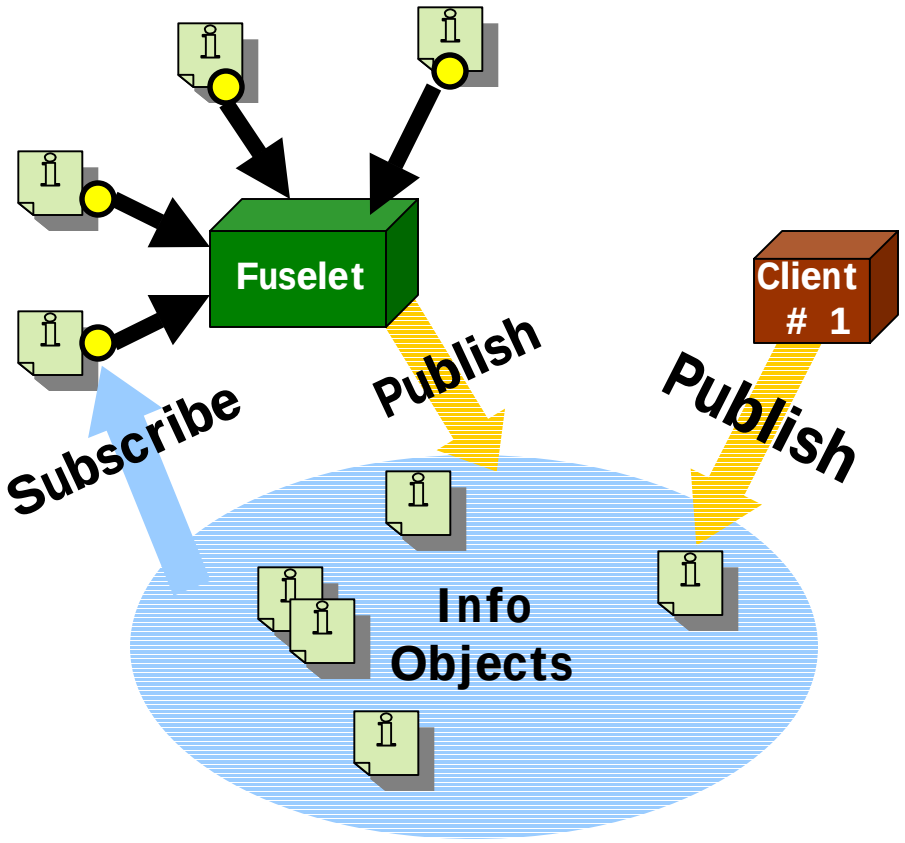
Query looks backward in time over the JBI repository (of objects)



Fuselets

"Tailoring the Information Space"

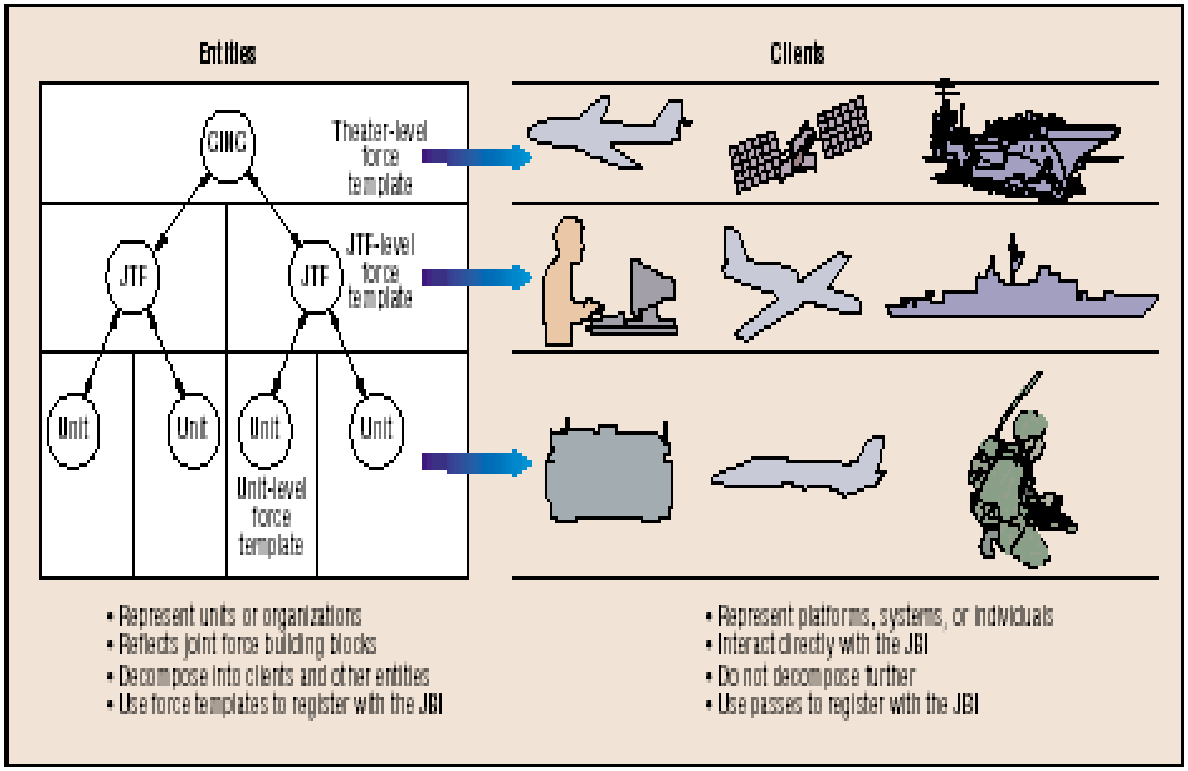
- Fuselets are "Special" JBI clients
- Publish new info object by refining or fusing other information objects
- Transforming data into knowledge

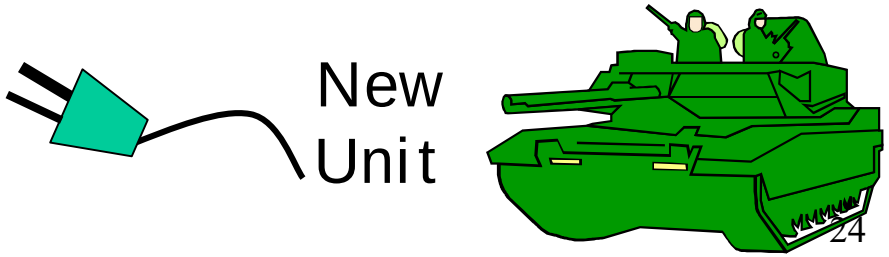


Force Templates

"Plugging into the JBI"

- Control entities that allow clients (at varying levels) to register/identify themselves to the JBI.
- Provide a mechanism for seamlessly integrating diverse coalition forces into these new information systems
- Enable new clients to come and go without modification of the JBI infrastructure





Distributed Collaboration

- Use of shared updateable knowledge objects
- Collaborative planning
  - "Shared whiteboard"
  - Multiple users interact with an application, see changes made by other users, and ultimately come to a common agreement/conclusion

JBI Program Profile

(6.2) Govt. Salaries $ 2 M +

(6.3) Contractors & Other $ 3 M =

Estimated Avg Annual Funding $ 5 M

JBI Team

Govt.

Military - 4

Civilian - 8

Contractors

In-House 12-15 (10 Companies)

Other (est. 12 Companies)

Collaborators (Several Orgs & Individuals)

Cornell Univ. –
Information Assurance Institute
DARPA
Other AFRL Groups

Contracting Vehicles

- IAC TATs
- SBIRs
- TOAs
- BAAs
- PRDAs
- Other …

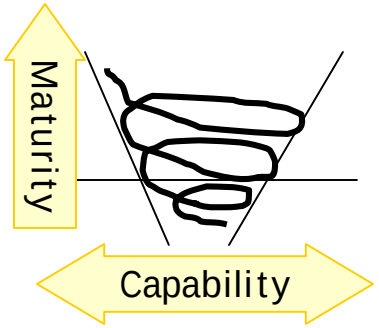
Program Management Activities

Requirements

The vision (and operational concepts) presented by Air Force Science Advisory Board is driving program activity – serving as the requirements guide.

Development

Implementing iterative (spiral) development process



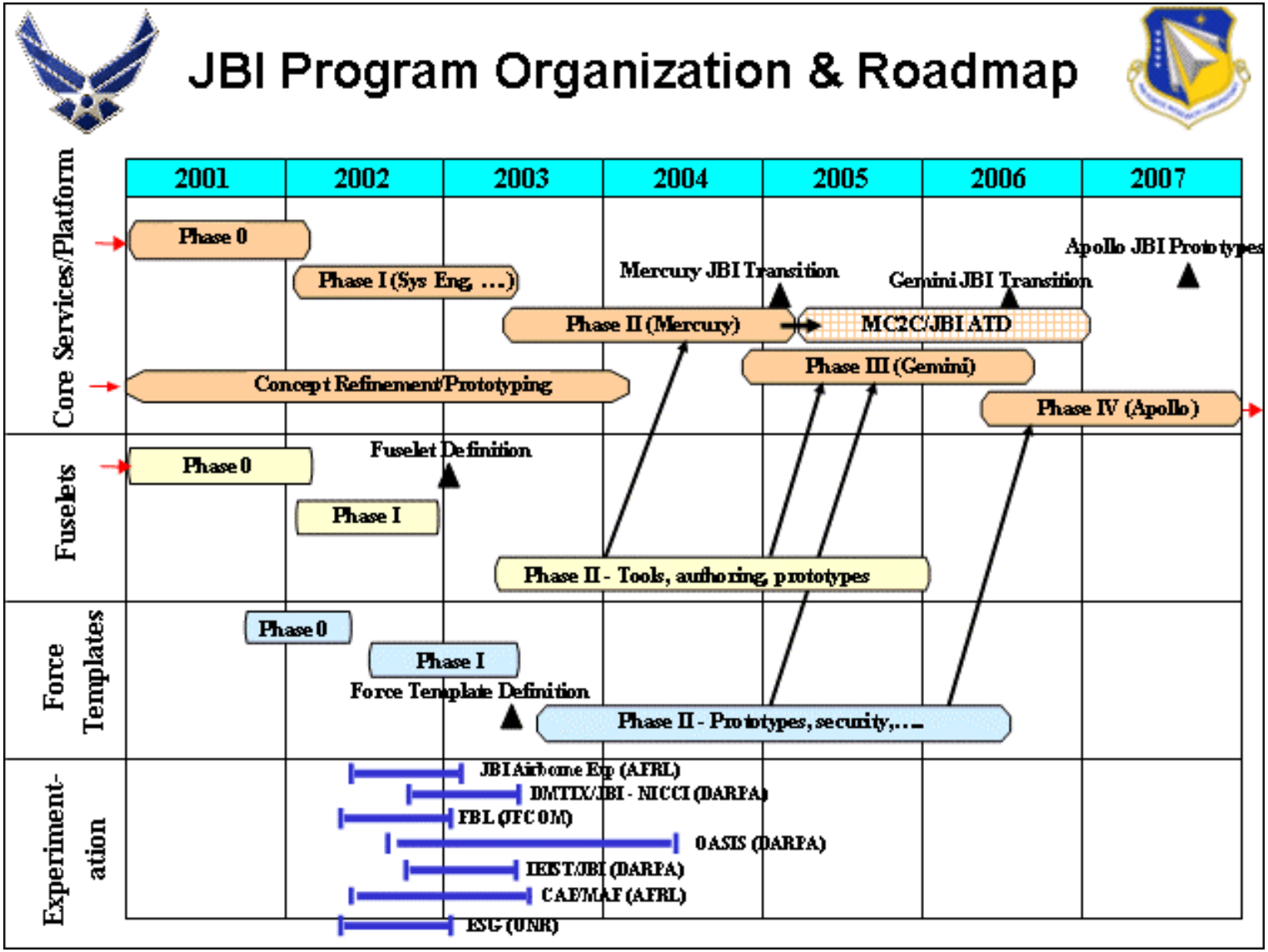
Roadmaps identify/schedule the tasks

–Each planned increment (phase) represents an increasing level of capability

Deliverables

Outcomes/products of each task or phase are typically documents that serve as requirements for future efforts resulting in technology transition.

JBI Program Organization & Roadmap



Section III

Information Gathering Approach for JBI Program

- Conducted interviews with AFRL leaders, and in-house contractor technical people
  - What are you doing ?
  - Why are you doing it ?
  - How are you doing it?
  - What are the biggest challenges? Issues? Successes?
- Answers to those questions revealed evidence of certain practices
- Followed with a series of questions designed to establish qualitative and quantitative data to support the degree of implementation of the practices.
- In parallel, gathered information from the JBI website

Awareness of "Gold Practices"

- JBI team is not cognizant of their activities as exemplifying "best practice".
- Recognize the intrinsic value ("Gold") of their practices to achieving the mission.
  - "We have to use the spiral(iterative) development process – there are too many unknowns". [Tech Director]
  - "Achieving interoperability is a principle requirement of the JBI – our main focus – not just something we try to do."
  - "To keep the cost down we have to achieve universality – and to do that we have to take the open systems approach."
- No formal plan for assessing the value of implemented practices –process improvement is considered important – but addressed informally.
- R & D "mindset" contributes to a lack of quantitative data to provide objective evidence of the "success" of these practices.

DACS Gold Practices

Implemented in JBI!

- Program Wide Visibility of Progress vs.. Plan
- Agreement on Interfaces
- Architecture-First Approach
- Ensure Interoperability
- Commercial Specifications & Standards/ Open Systems
- Configuration Management
- Leverage COTS/NDI
- Require Structured Development Methods (Iterative Processes)
- Plan for Technology Insertion
- Demonstration-Based Reviews

- Binary Quality Gates at the Inch Pebble Level
- Track Earned Value
- Manage Requirements
- Formal Risk Management
- Formal Inspections
- Metrics-Based Scheduling and Management
- Defect Tracking Against Quality Targets
- Quantitative Progress Measurement

Noticeably Absent!

Program-Wide Visibility of Progress vs. Plan

… the practice of sharing core indicators of project health (or dysfunction) with <u>all</u> project participants

- Weekly meeting of entire AFRL JBI team
  - Well attended –perceived as worthwhile by some developers
  - Project/task status reported
  - Issues discussed openly

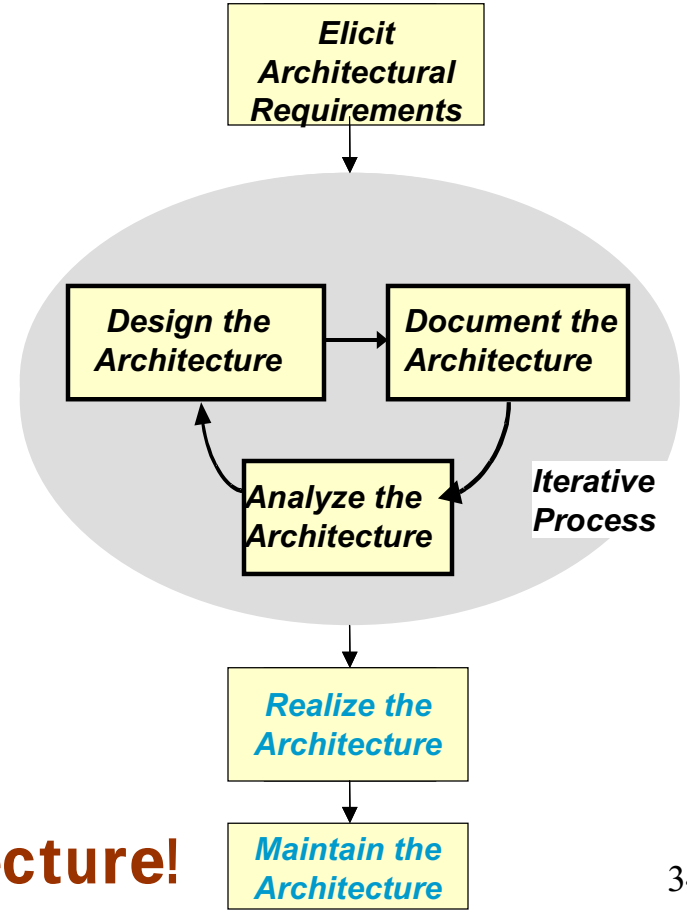
Core Indicators Of Project Health?

- Principle Investigators Conference (Spring & Fall)
  - Formal JBI status review

Architecture-First Approach

The practice of seeking a demonstrable balance among driving requirements, architecturally significant design decisions, and the life-cycle plans to develop an architecture before resources are committed for full-scale development.

- Using skilled architects
- Considering alternative designs
- Solicited architectural ideas from the technical community (Y-JBIs)
- Leveraging commercial middleware
- Using Zachman framework for architecture representations
- Architecture is evolving
- Have initial release of a JBI architecture available for review by interested parties
- Challenge of interoperability remains



JBI is architecture!

Ensure Interoperability

Ensuring the ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together.

- Interoperability is a primary goal of JBI – and the primary challenge.
- Achieved at the architecture level (Architecture must demonstrate interoperability)
- Established an in-house test cell for the purpose of evaluating prototypes with respect to issues of interoperability.
  - Comprised of govt. and in-house contractors
  - Independent from contractors doing development

What degree of interoperability is acceptable?

Commercial Specifications & Standards/ Open Systems

The practice of developing a technical and business strategy for software intensive systems that defines key interfaces by widely-used consensus-based standards. Standards are selected based on maturity, market acceptance, and allowance for future technology insertion

- Standards-based development – not standardization
- Just like the plug that goes into the outlet JBI clients must conform to specs in order to "connect" to JBI
- Now have a spec for the common API (JBI platform)
  - Using JBOSS, JMS, ORACLE REPOSITORIES

Process for Selecting Standards?

Configuration Management

The discipline of identifying the configuration of a hardware/software system at discrete points in time with the purpose of systematically controlling changes to the configuration and maintaining the integrity and traceability of the configuration throughout the system lifecycle.

- Developers of the common API (JBI platform) are using CVS, an **open source configuration management system**, for tracking the source code used in each of alternate versions of the prototypes under development.
- CM policy is communicated verbally to new developers. No formalized CM plan.
- Developers view CM as “annoying, but necessary” to support the mission.

Leverage COTS/NDI

The practice of identifying/using Commercial Off-The-Shelf software,and/ or Non-Development Items in lieu of custom-developed components in order to reduce costs and/or improve quality over the product life cycle.

- Developing architecture for COTS middleware
- JBI tasks identify/explore commercial/NDI technology
  - Information Objects:
    - XML, X technologies
    - Semantic Web : RDF, DAML + OIL
  - Pub/Sub/Query:
    - IBM MQ Series
    - Tibco Rendevous
    - Talarian Systems
  - Fuselets: Computer Associates' "Neugents"
  - Force Templates:
    - Texar Secure Realms
    - Oracle Internet Directory
    - Netscape iPlanet

How do these candidate solutions impact interoperability goals?

Plan for Technology Insertion

Planning how to take advantage of future technology opportunities to improve the performance or reduce the cost of the system by replacing existing system components with newer technology components as they become available.

- The design of JBI is itself a plan for technology insertion.
- Milestones for insertion
- Challenge is to ensure technology insertion while optimizing use of COTS, and without sacrificing interoperability.
- Implementing "plug –n-play"

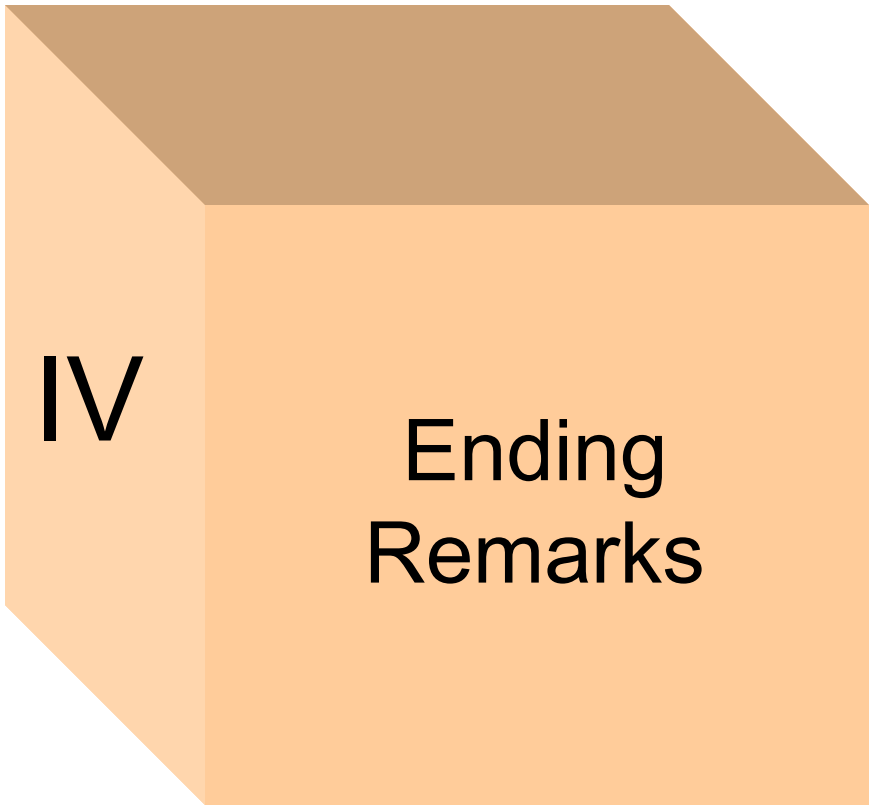
How do we validate the technology insertion capability?

Demonstration-based Reviews

… the practice of using executable demonstrations of relevant scenarios as an integral part of project reviews to stimulate earlier convergence on integration, support tangible understanding of design trade-offs, and eliminate architectural defects as early as possible

- Demonstration is the primary review method for most tasks on the JBI at all levels.
- Formal demonstrations are project/phase milestones
- Demonstrations serve as gates(decision points) for further action and funding

Section IV



GP Implementation on JBI

Focus is on the mission – not on process improvement.

Assessment of GP implementation on JBI triggers many questions:

- What degree of implementation is necessary in order to claim that the practice has been implemented?
- Can we (should we) attempt to refine, and perhaps standardize the definitions of GPs?
- What information must an organization provide to support its perception of intrinsic value of a GP?
- How can we capture the "value added" by a GP implementation at minimal cost to the implementing org?
- Are there specific collections of GPs that must be implemented together in order for any of them to be successful?
- Is there a set of GPs that provide value unique to the R & D community? (The same set would not work well outside of R& D)

Status of DACS Initiative

- GP Web Site
  - Under development
  - Available in late Spring
- GP Architecture and Profiles
  - Initial drafts published as a GP Quick Reference on CD ROM
  - Available in Spring
- Survey is ready
  - Available in Excel format
  - Identifying information is required
- DACS is looking for organizations willing to develop case studies

Future DACS Plans

- Partner with implementing organizations to develop useful case studies
- Continue monitoring the JBI program
  - Focusing on practice interrelationships and
  - Evolution of identified practices
- Identify and implement other activities deemed appropriate to educate the DoD community and encourage use of GPs.

DACS welcomes any dialogue or ideas you may have!
Please contact us!

References/POCs

AFRL JBI Program

JBI Program Web Site [http://www.rl.af.mil/programs/jbi/default.cfm]

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Program Manager	315-330-7652	587-7652
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